Client Computers

Local Area Network and switch

Computer elements

Common File System

Figure 1: Current Architecture Network-Attached Storage system With Tightly-coupled Computer Elements
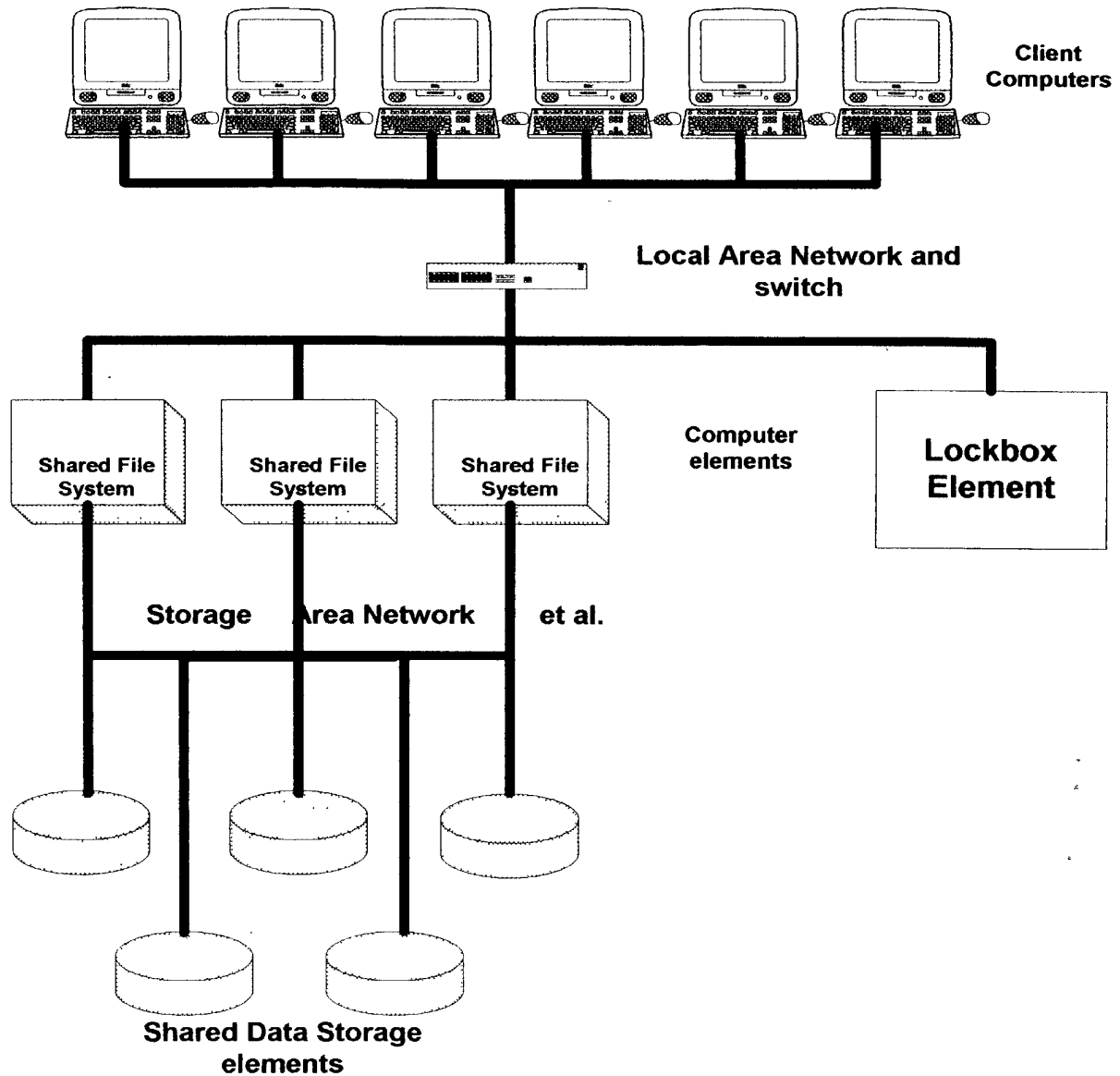
**Figure 2: Current Architecture Network-Attached Storage system
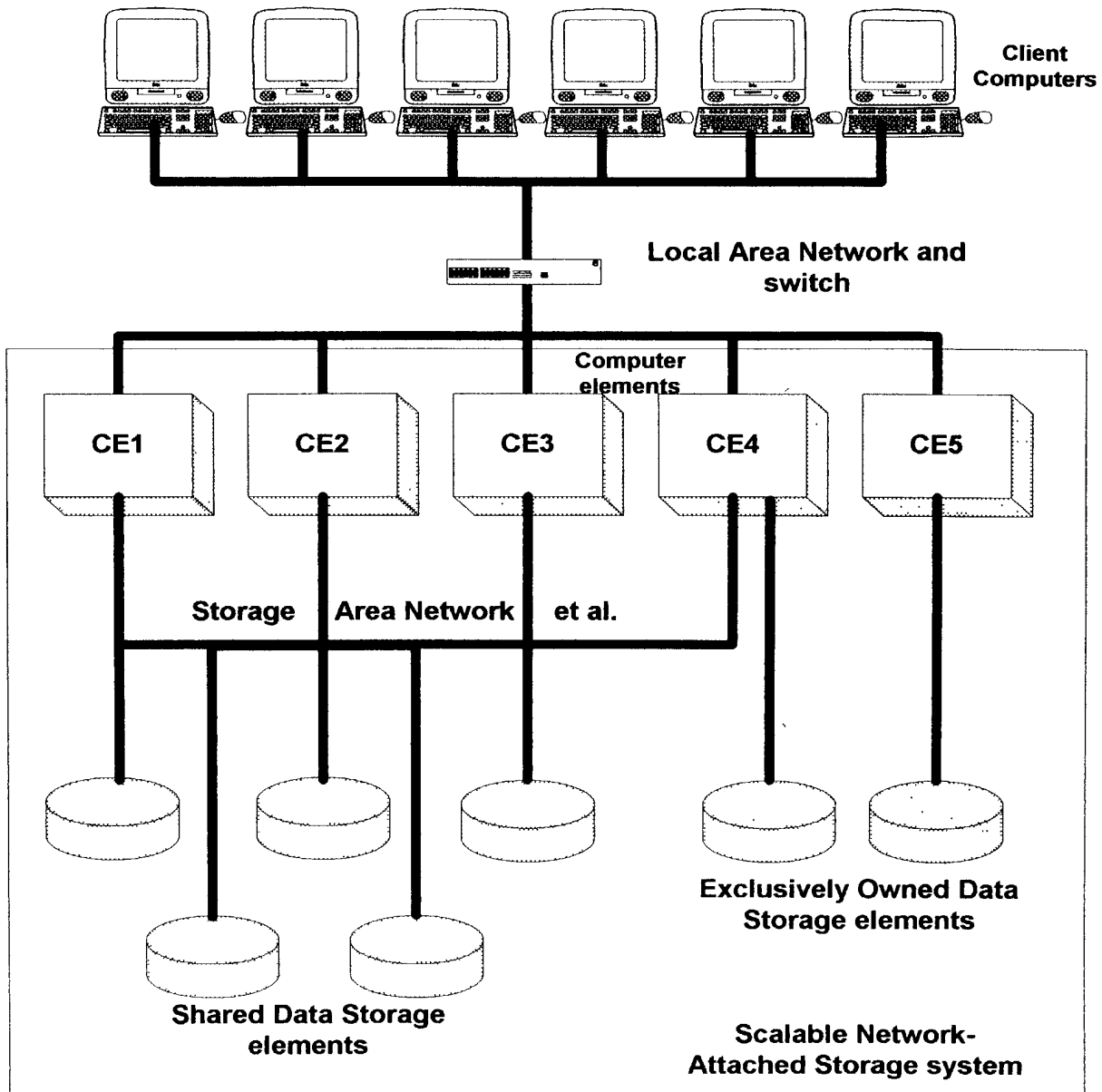With Loosely-coupled Computer Elements**

**Figure 3: Scalable Network-Attached Storage System
Hardware Elements**
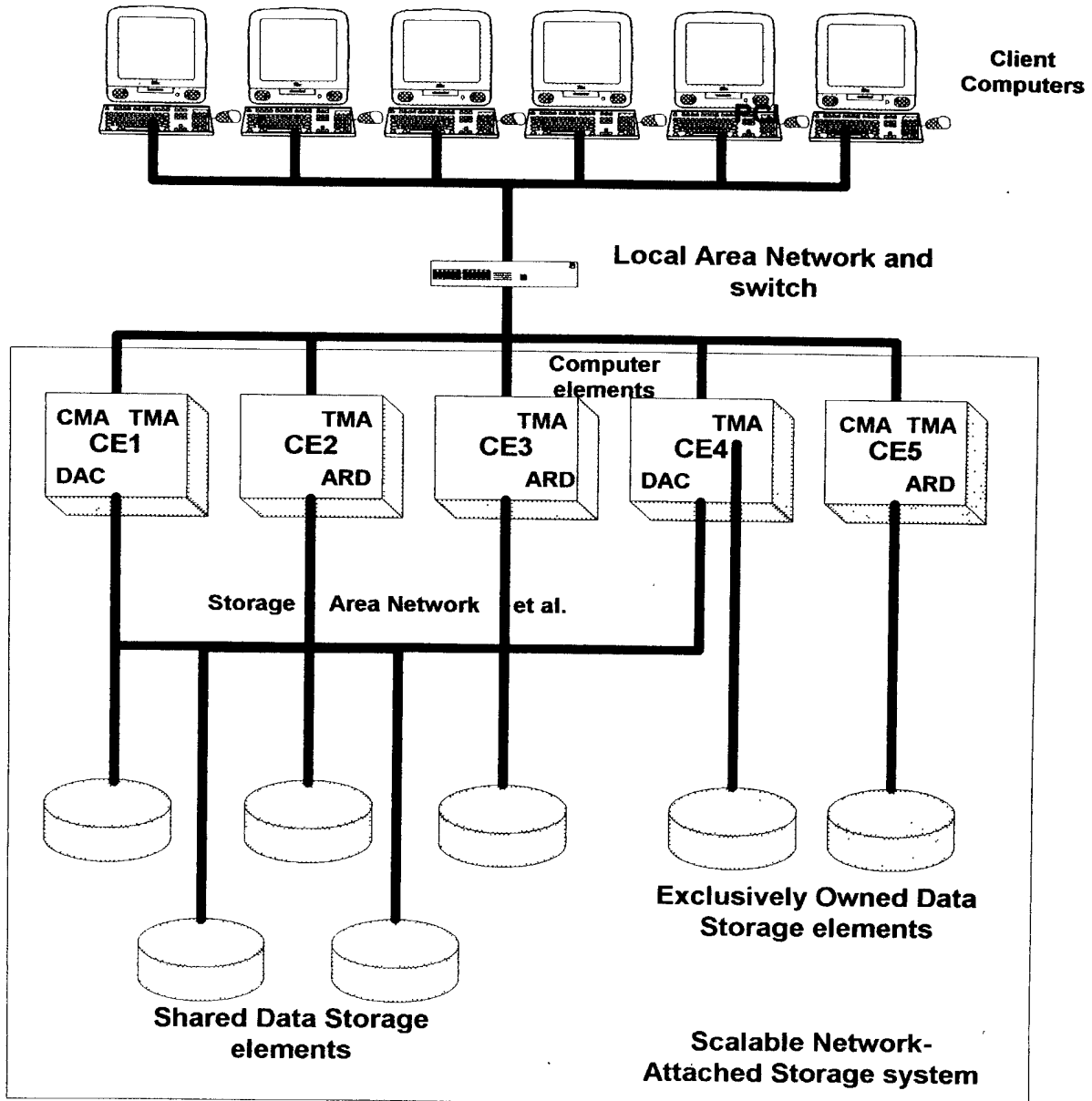
Figure 4: Scalable Network-Attached Storage System
Software Elements Shown on Hardware Elements

Drive A

Client Computer's view of the Data Storage Elements of the SNAS system

— Folder A

— Folder B

Folder B.a   Folder B.b

File X   File Y

— Folder C

Data storage elements mapped to Computer Elements

Folder A   Folder C   Folder B   Folder B.a
                        Folder B.b

CE1   CE2   CE3   CE4   CE5

File X   Folder B.b   Folder B.a

Folder B

Folder A, Folder C

Data storage elements mapped to Physical Storage
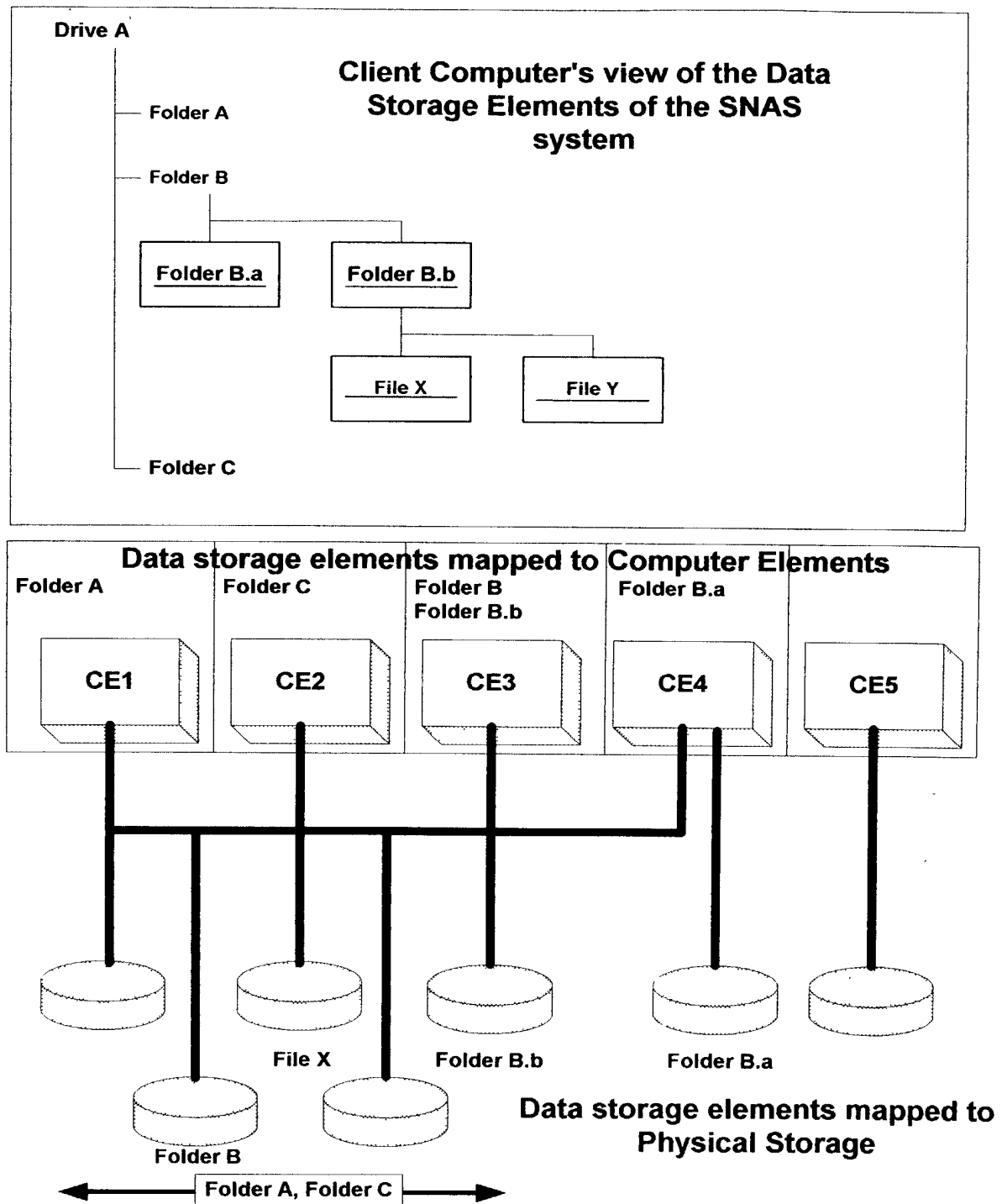
Figure 5: Mapping of Data Storage Elements

Drive A

Client Computer's view of the Data Storage Elements of the SNAS system

— Table A

— Table B

Record B.1   Record B.2   Record B.3   Record B.n

— Table C

Data storage elements mapped to Computer Elements

Table A	Table C	Record B.2	Record B.1 Record B.3	Record B.n
CE1	CE2	CE3	CE4	CE5

Record B.1   Record B.3   Record B.n

Data storage elements mapped to Physical Storage

Record B.2

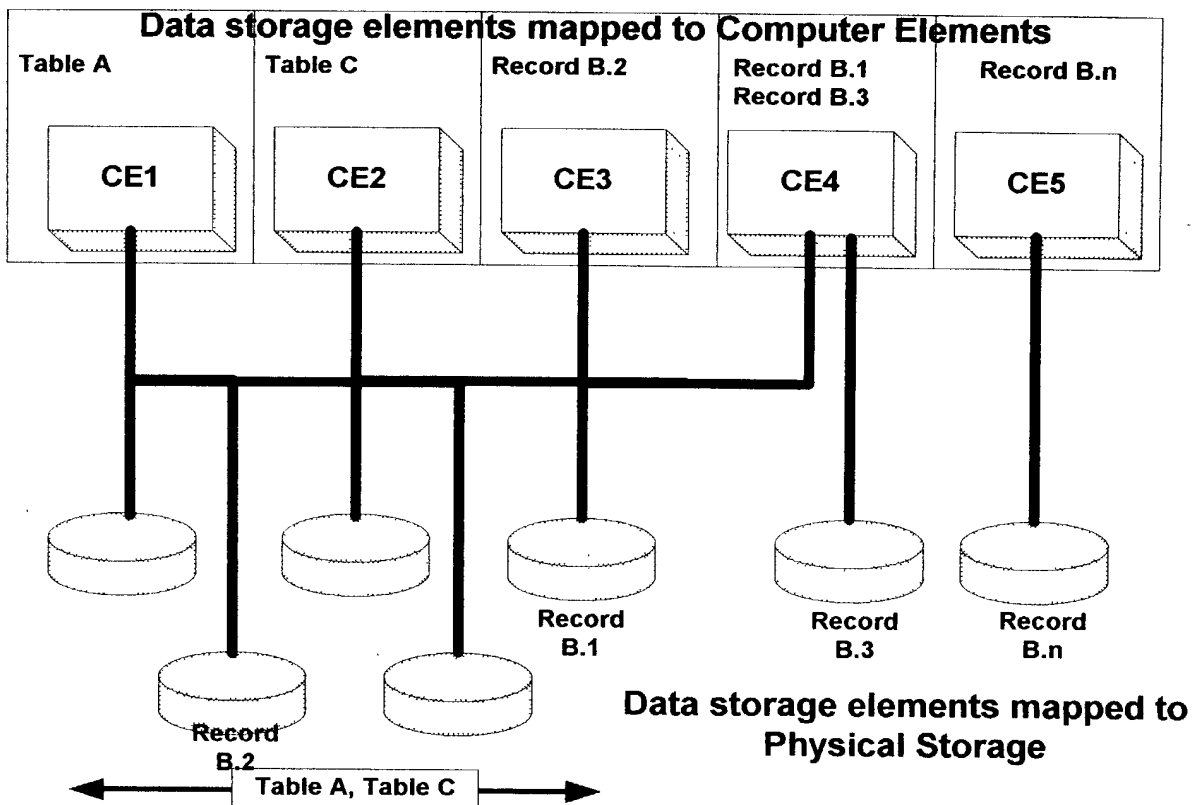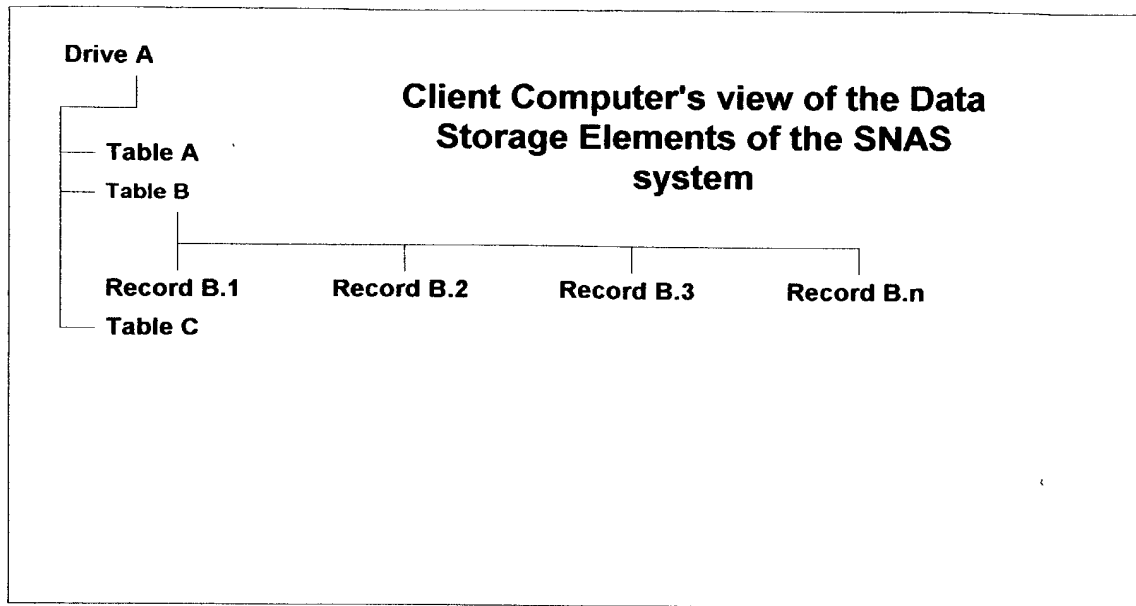Table A, Table C

Figure 6: Mapping of Data Storage Elements in a Database-type System
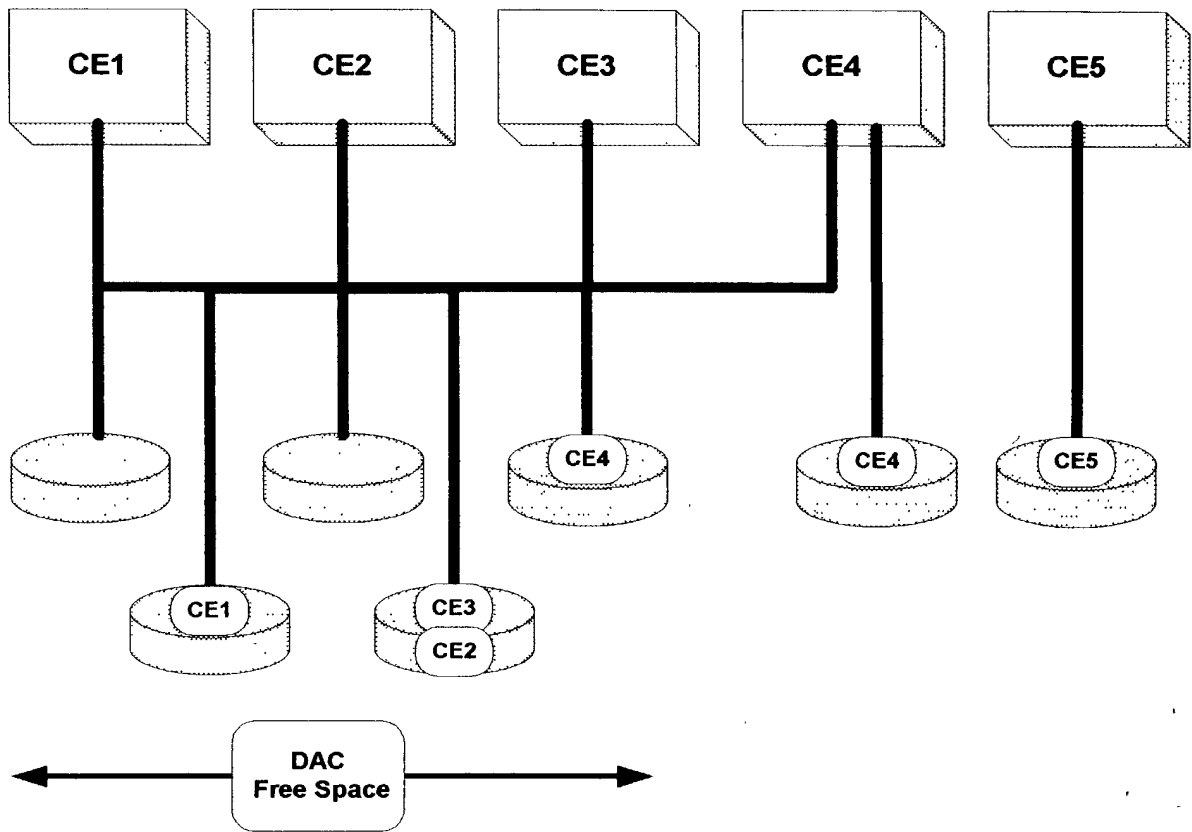
Figure 7: Two-Tier Mapping of Free Space onto Data Storage Elements

Folder A	Folder C	Folder B Folder B.b	Folder B.a	New Computer Element
CE1	CE2	CE3	CE4	CE5

Folder
B.b

Folder
B.a

Folder B

Folder A, Folder C
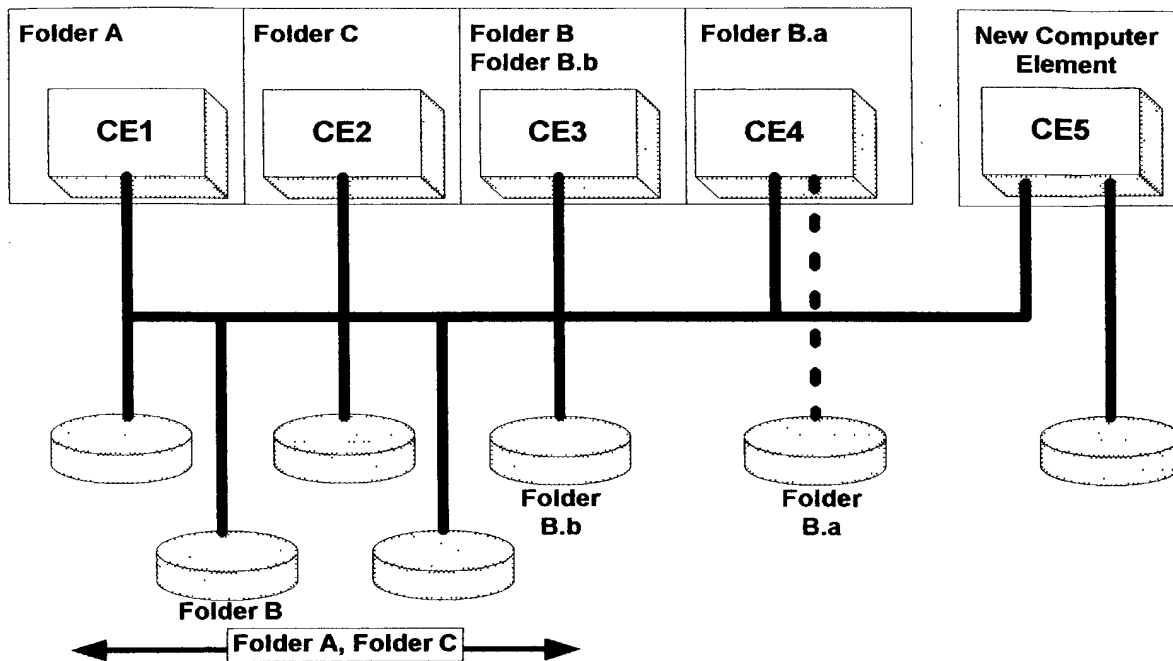
Fig 8a:Map just as New Computer Element is added

Folder A	Folder C	Folder B	Folder B.a	Folder B.b
CE1	CE2	CE3	CE4	CE5

Folder
B.b

Folder
B.a

Folder B

Folder A, Folder C
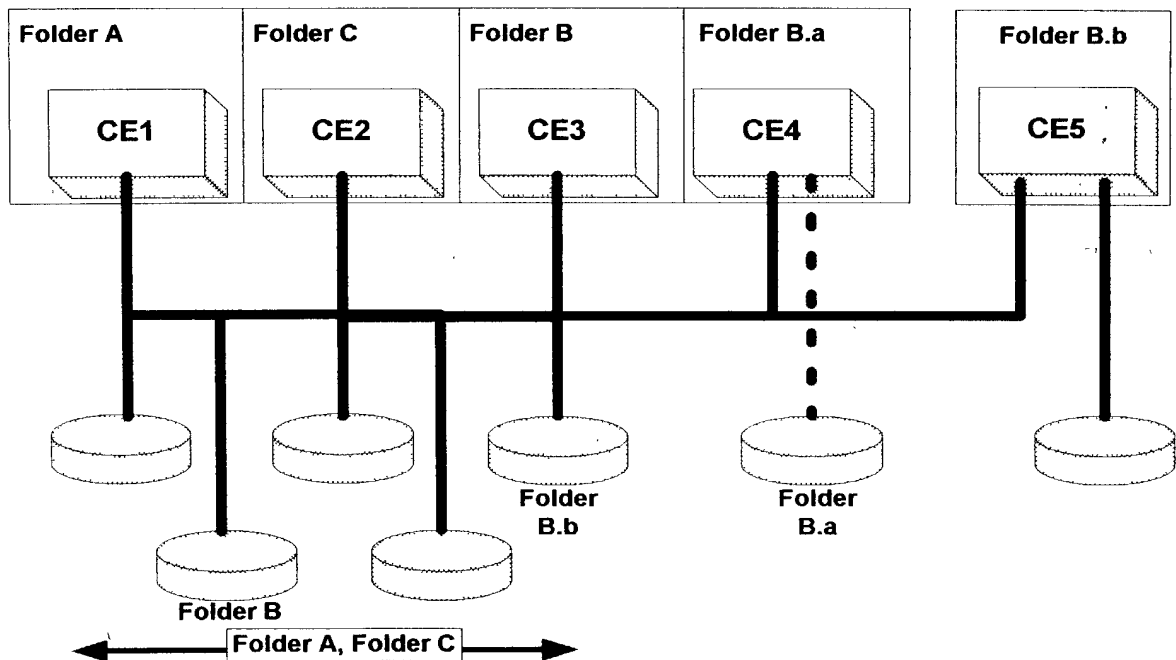
Fig 8b:Map After DAC has Re-allocated

Figure 8: Scaling of Computer Elements

Folder A Backup Folder B.b	Folder C Backup Folder B.a	Folder B Backup Folder C	Folder B.a Backup Folder C	Folder B.b Backup Folder A
CE1	CE2	CE3	CE4	CE21

Folder B.b

Folder B.a

Folder B

Folder A, Folder C

Fig 9a: Map with Backup Map Prior to Failure

Folder A Folder B.b	Folder C Backup folder B.a	Folder B Backup Folder C	Folder B.a Backup Folder C	Backup Fold A
CE1	CE2	CE3	CE4	CE

Folder B.a

Folder B.a

Folder B

Folder A, Folder C

Fig 9b: Map Re-allocated After Failure

Figure 9: Backup Map Concept

Local Area Network and switch

Computer elements

CE1   CE2   CE3   CE4   CE5

DRA   DRA

Storage Area Network et al.

Exclusively Owned Data Storage elements

Shared Data Storage elements

Scalable Network-Attached Storage system

Figure 10: Local Replication
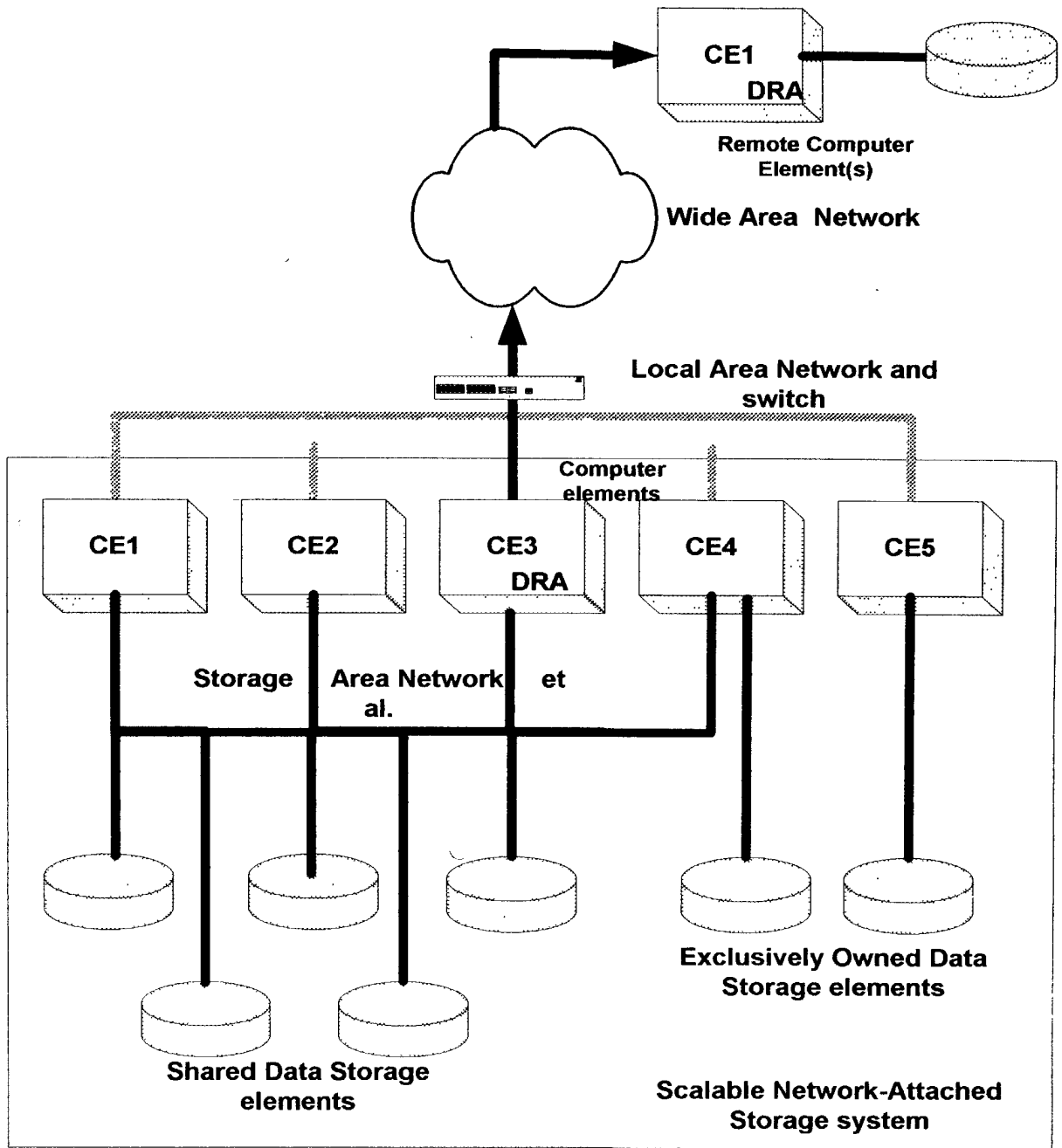
Figure 11: Remote Replication

Folder A
File X

Folder C
File X Write-
enabled

Folder B
Folder B.b

Folder B.a
File X

CE1　　**CE2**　　**CE3**　　**CE4**　　**CE5**

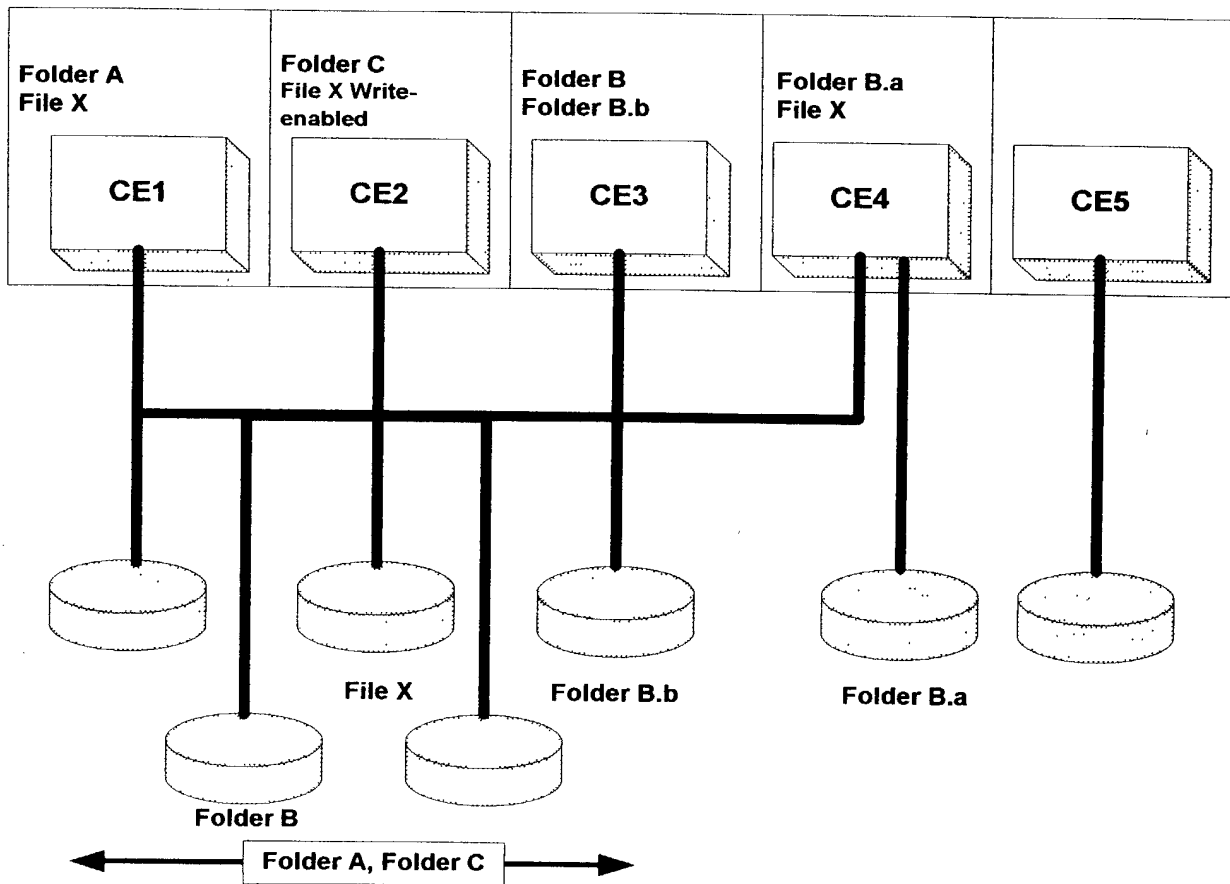File X　　Folder B.b　　Folder B.a

Folder B

Folder A, Folder C

Figure 12: Access Replication
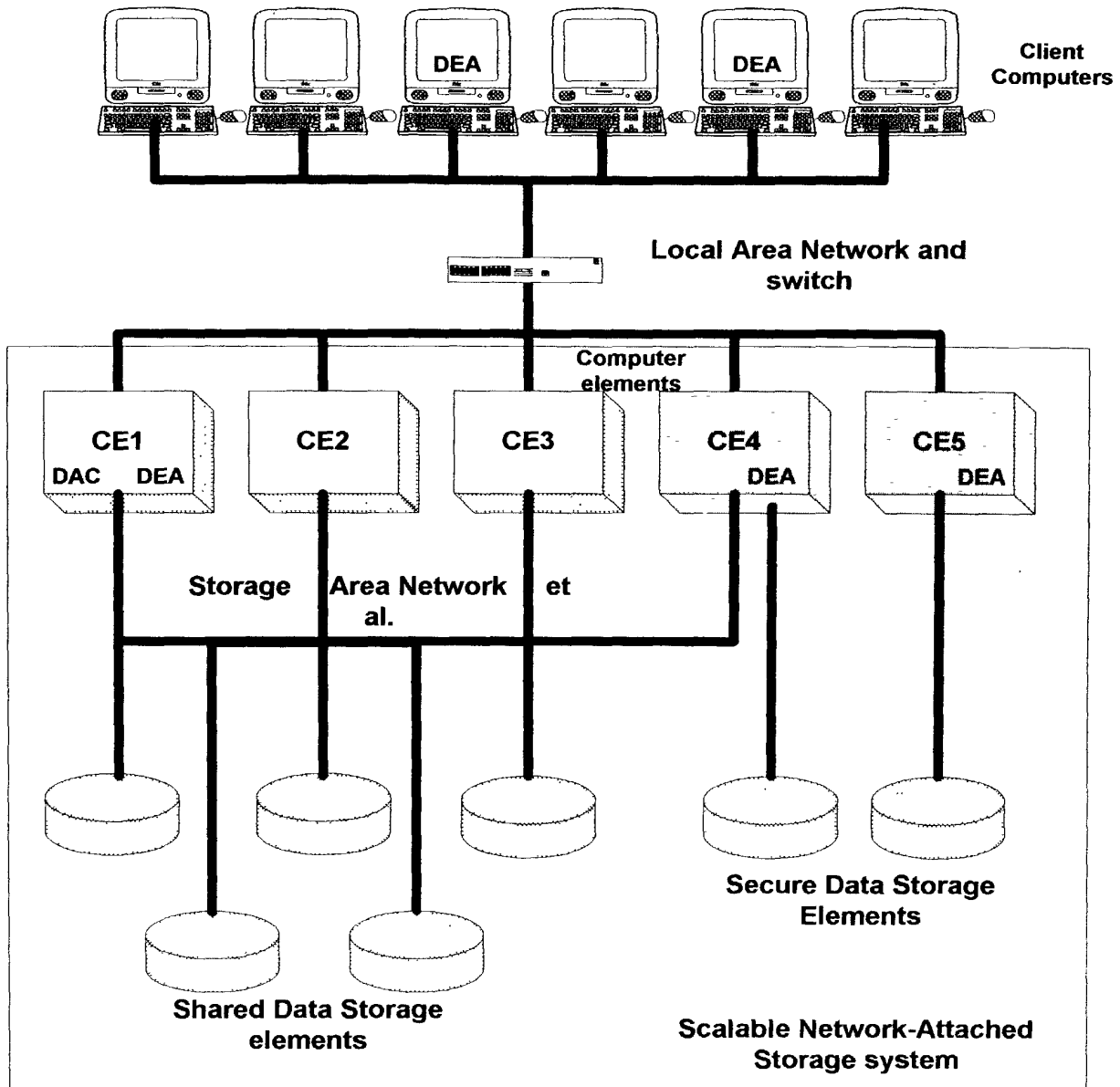
Figure 13: Secure-SNAS System
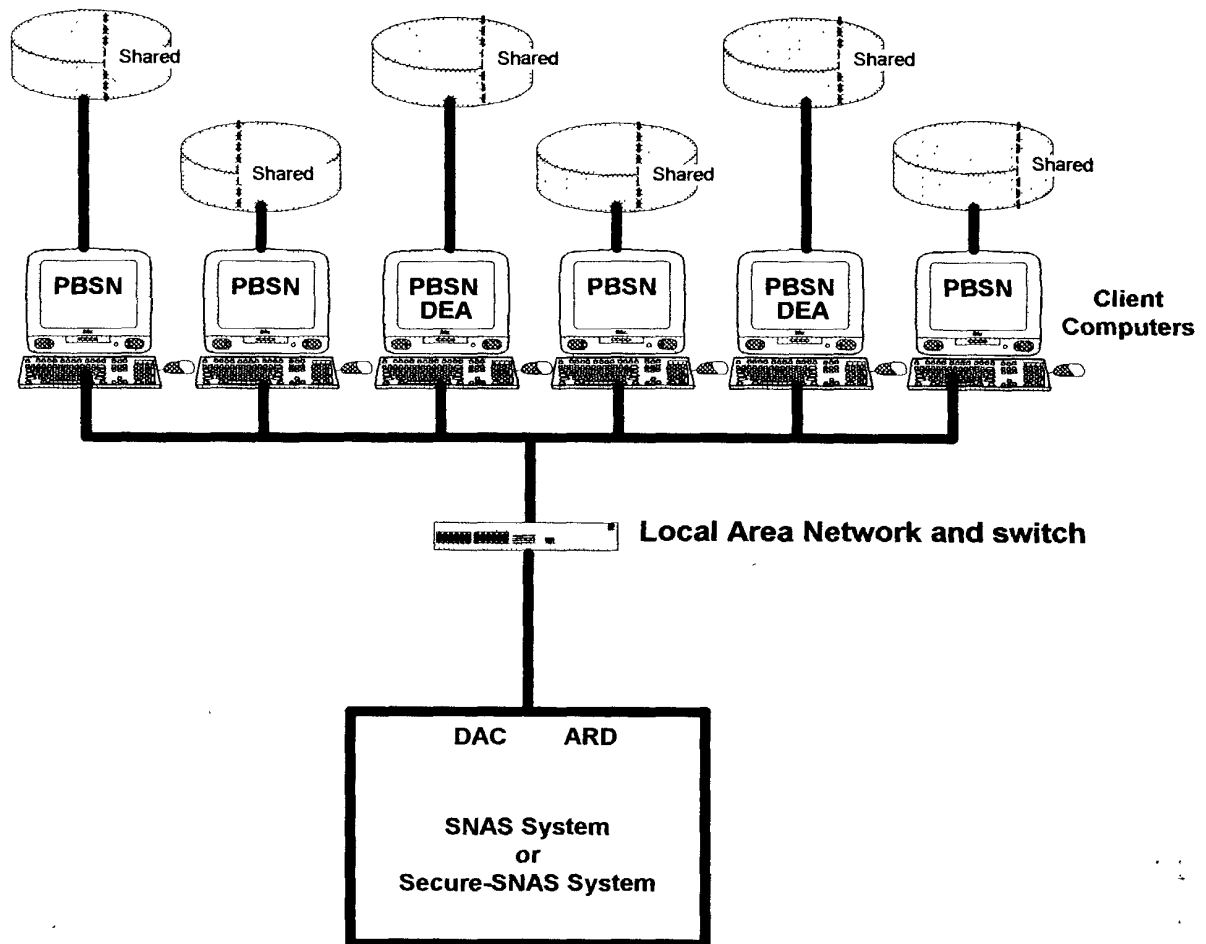
Figure 14: Peer-Based Storage Network

Folder XXX (Owner)

Shared   Shared   Shared

Folder XXX

Shared   Shared   Shared

PBSN   PBSN DEA   PBSN   PBSN DEA   PBSN   **Client Computers**
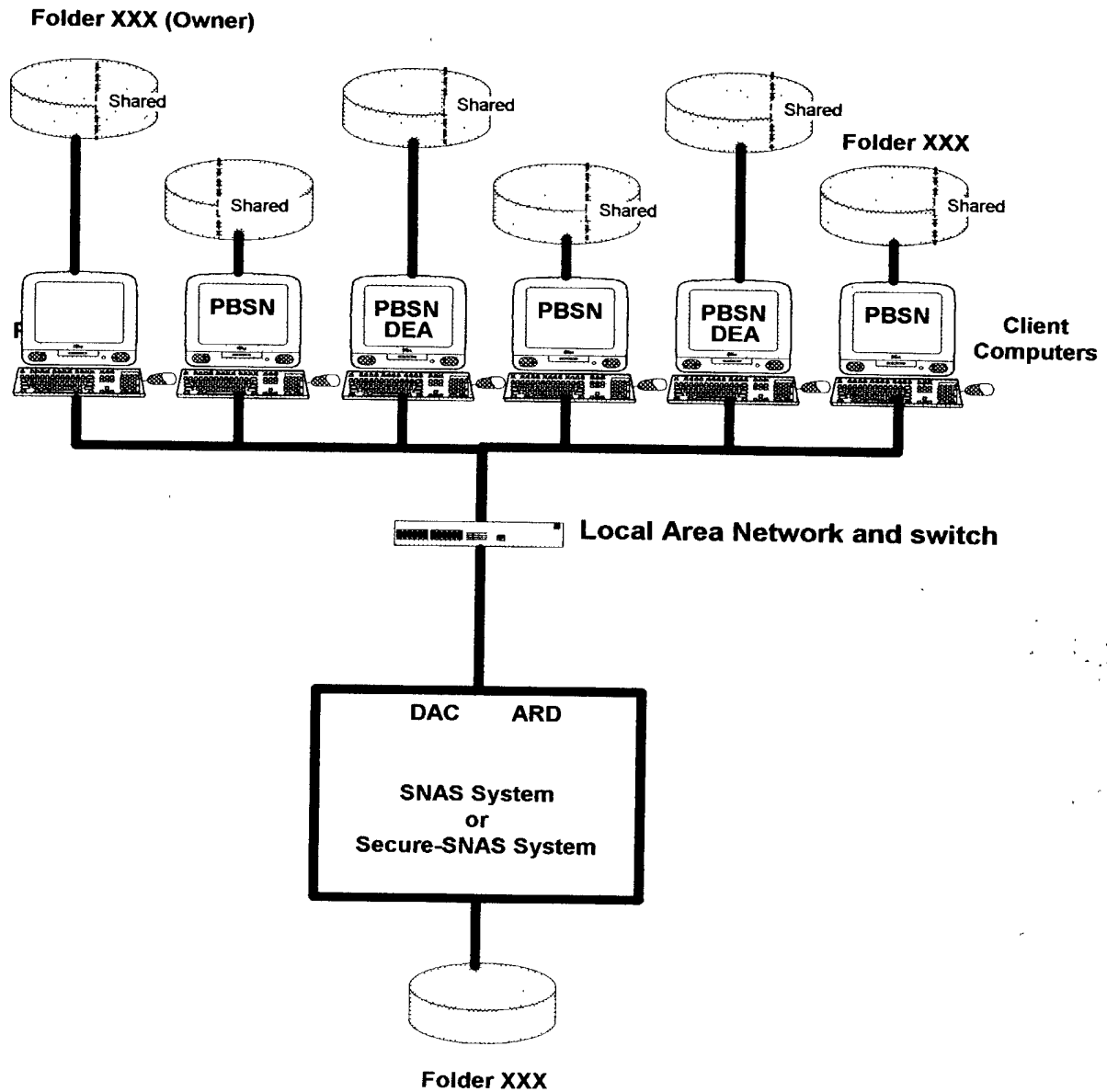
Local Area Network and switch

DAC   ARD

**SNAS System
or
Secure-SNAS System**

Folder XXX

**Figure 15: High Availability User Network Based on
Peer-Based Storage Network**

**Folder XXX
(Owner)**

Shared

Shared

Shared

Folder XXX

Shared

Shared

Shared

| PBSN | PBSN | PBSN DEA | PBSN | PBSN DEA | PBSN |

**Client
Computers**

Local Area Network and switch

ARD

DAC

**SNAS System
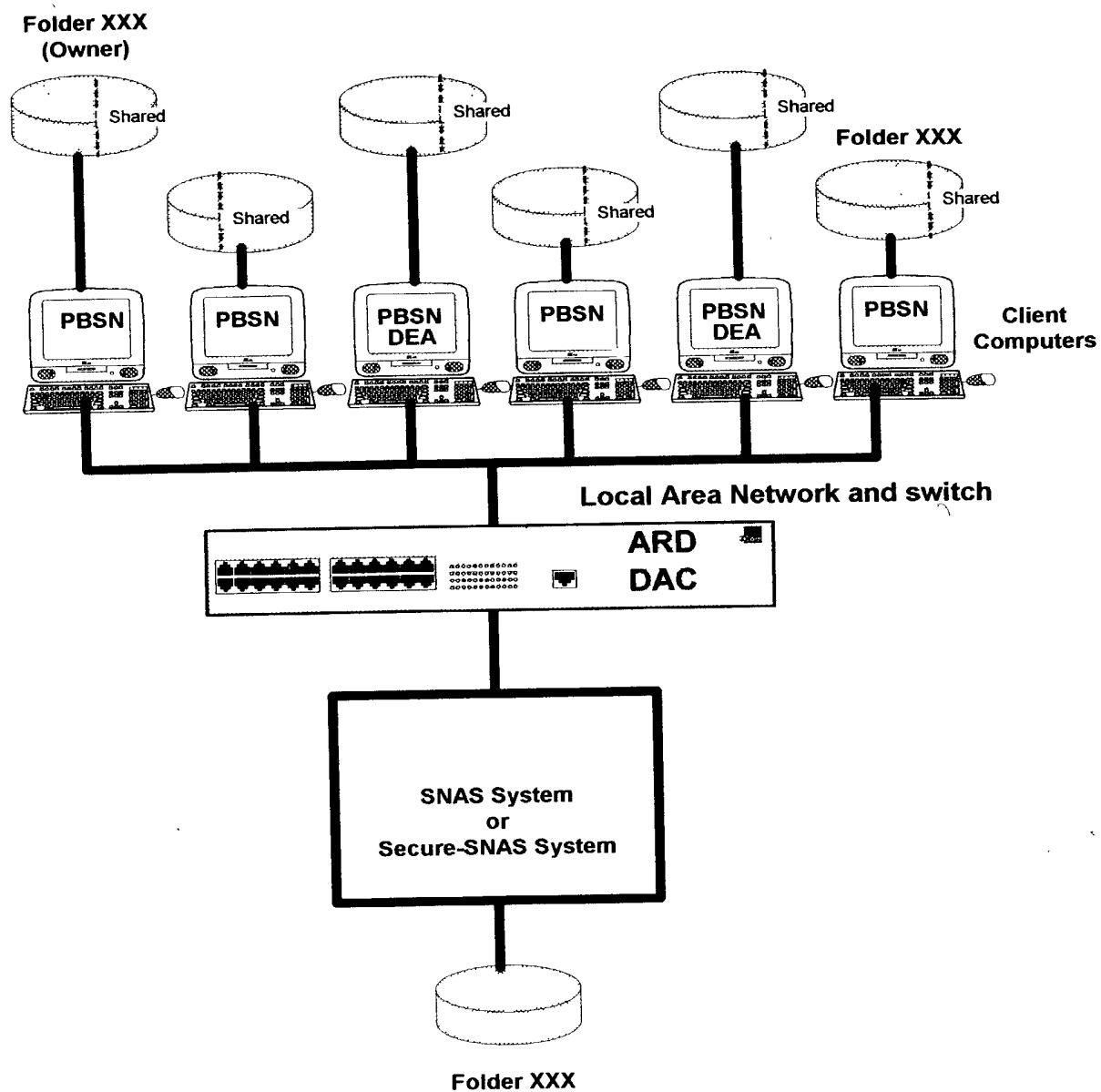or
Secure-SNAS System**

Folder XXX

**Figure 16: An Alternative Construction with
DAC and ARD Functions in Network Switch**